

Cryomodule 2 (CM2) Transportation & Installation at NML

Tug Arkan, 4/27/2012

RFCA002 a.k.a. CM2 was assembled at the Cryomodule Assembly Facility (CAF) at FNAL between July 2011 and March 2012. CM2 is currently residing at CAF-ICB ready to be transported to the NML test area.

The document titled "Technical Specification for NML-CM2 Interfaces" prepared by TD engineer Ken Premo is the governing documentation to be used by the TD and NML groups for CM2 mechanical, vacuum and electrical system interfaces. All the other engineering documentation for CM2 is located at the below location:

<http://ilc-dms.fnal.gov/Workgroups/CryomoduleDocumentation/CM2-folder/>

It is highly recommended that AD NML personnel consult with the TD personnel for any modification or repair of CM2 components. Until the operational readiness clearance is approved by the TD division head and accepted by the AD Division Head, CM2 shall not be operated (high power applied and/or cooled down) at NML. The mechanical and vacuum installations and any modifications to same shall not be made without consultation with the TD responsible engineer, Tug Arkan.

Phase – I: Transport of CM2 to NML:

Mike McGee is the responsible engineer for the transport of CM2 from CAF-ICB to NML. A procedure and hazard analysis was written by Mike for this planned transport.

This document can be found at the above mentioned URL under the "CM2 Shipping Plan" folder. The transport will involve loading the transportation fixture to air ride flat back truck, instrumenting the module and the fixture, and loading CM2 to the fixture at CAF-ICB. TD CAF group will be responsible for this part of the transport.

Once the CM2 arrives at NML, the module will be off-loaded from the truck and it will be staged on concrete shielding blocks outside of the test cave for installation of the large bellows. AD NML group will be responsible for this part of the transport. TD Engineer Tug Arkan and AD Engineer Jerry Leibfritz will oversee the transport from CAF-ICB to NML. Mike McGee is the responsible engineer to ensure that CM2 is safely transported and installed to the test area at NML. After CM2 is installed on its stand at NML and aligned, the lifting girder needs to be uninstalled from the module. NML group shall consult with TD CAF group about the proper use of the lifting girder as needed. The lifting girder has an in-built capability so that the center of the gravity of the module can be adjusted under the load while it is suspended with the crane.




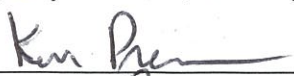
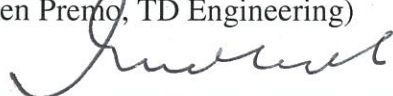
It is NML group's responsibility to assure that the CM2 will fit on its stand and in the planned enclosure. TD CAF group has already provided the module feet assembly to NML group in FY11. It is NML group's responsibility to assemble the feet and install on module stands at NML before CM2 arrives to NML. The DESY/ INFN drawing number for the feet assembly is: TTF-CRY3-01.02.00

CM2 as-is at CAF-ICB:

1. The beam line (cavity string) is currently backfilled to positive 50 mbar gauge pressure with boiled off gas nitrogen.

2. Cavity string gate valves at the upstream end and downstream end are open. The right angle valves attached to both gate valves are closed and locked. The keys for these locks will stay with the TD responsible engineer until CM2 responsibilities are transferred to the AD NML group.
3. Sliding bellows (DN1100) at the upstream end of the module will not be installed during the transport. The bellows used on CM1 will be used again for CM2. When transporting CM1 to CAF-ICB, NML group needs to assure that sliding bellows is disassembled and stays at NML to be used on CM2.
4. Two of the 3 cold mass support post covers were installed during the transport. The middle cold mass support post cover has a pressure relief valve (parallel relief plate) which interferes with the lifting girder therefore it is not assembled during the transport to NML. The open middle post will be covered with plastic protective wrap.
5. The coupler pumping lines were installed and leak checked during the CM2 assembly at CAF-ICB. The right angles valves for each coupler warm part (8) are currently closed.
6. The ion pump and the titanium sublimation pump (TSP) for the coupler pumping line are not installed. The flanges were blanked-off during the transport. These pumps were procured by the NML group.
7. All the internal coax RF cables, temperature sensor cables, geophone cables, cavity tuner stepping motor cables, magnet current leads were terminated and checked to their appropriate instrumentation flanges by the TD IB1 electrical group during the assembly of CM2. NML group should check the interface document to identify the instrumentation flanges and appropriate connectors used for CM2 assembly. The quality assurance documents for the assembly and check of these cables and connectors are at TD IB1 electrical group database.

Phase-I Sign-offs:

Prepared by: <u></u>	Date: <u>5/1/2012</u>
(Tug Arkan, Cryomodule Production Engineer)	
Approved by: <u></u>	Date: <u>5/2/2012</u>
(Tom Peterson, TD Engineering)	
Approved by: <u></u>	Date: <u>5/4/12</u>
(Jerry Leibfritz, AD Engineering)	
Approved by: <u></u>	Date: <u>5/1/2012</u>
(Ken Premo, TD Engineering)	
Approved by: <u></u>	Date: <u>5.01.2012</u>
(Vyacheslav Yakovlev, TD SRF Dept. Head)	

Approved by: S. Nagatsev
(Sergei Nagatsev, AD NML Head)

Date: 5/8/12

Approved by: Giorgio Apollinari
(Giorgio Apollinari, TD Division Head)

Date: 5/1/12

Approved by: Roger L. Dixon
(Roger Dixon, AD Division Head)

Date: 5-8-12

Phase – II: CM2 at NML before ORC is approved:

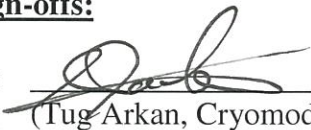

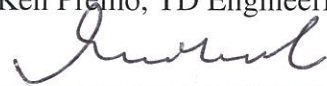
This is the phase of work related to CM2 after it is transported to NML and situated on its stand in the enclosure. The ORC documentation is not yet approved by the TD and AD division head, therefore the ownership and the responsibility of CM2 belongs solely to TD. AD NML group shall consult with the TD responsible engineer, Tug Arkan, for any planned work on CM2 before the work is performed at NML. It is recommended that the perimeter of CM2 was roped off and warning signs placed so that the access to the module is restricted accordingly. AD NML shall identify a person to assure that the responsibility process is enforced for CM2.

The below tasks need to be performed at NML after CM2 is situated on its stand: The scheduling of these activities will be determined by Tug Arkan and Jerry Leibfritz.

1. TD CAF group with the assistance of the NML group will install the big sliding bellows to the CM2 upstream end at NML.
2. AD NML group will install the middle cold mass support post cover. The o-ring for this cover shall be slightly coated with Apiezon vacuum grease before the cover is attached to the vacuum vessel flange.
3. NML group is responsible for installing the coupler pumping line pumps and leak checking the flanges accordingly. UHV working practices are recommended during the installation of these pumps.
4. Insulating vacuum of CM2 will be checked at ICB with the vacuum end caps installed. It will also be leak checked again at NML after the feed and end can connections are made.
5. There are six Cernox sensors that need to be installed in the CM2 GRHP. Three sensors are for the upstream end and other three are for the downstream end. These sensors need to be installed before CM2 is installed on its stand at NML. TD IB1 electrical group along with NML group shall install and conduct the QA of these sensors.
6. TD IB1 electrical group will do a thorough QA check of all the instrumentation flanges in coordination with appropriate AD/NML personnel. TD RF engineer Timergali Khabiboulline shall perform RF measurements for the cavities as needed with the network analyzer in coordination with appropriate AD/NML personnel. Results of these QA checks will be provided to the NML group for their records. If a repair task is needed after the QA, TD responsible engineer Tug Arkan shall be consulted accordingly.
7. The cavity tuner motors and tuner piezo sub-systems shall be checked by the TD IB1 electrical group under the strict supervision of Yuriy Pischalnikov and in coordination with appropriate AD/NML personnel. *Caution: The cavity tuner stepping motor is fragile equipment and it can be easily damaged if it is operated without proper instruments and proper voltage.*
8. FNAL Alignment & Metrology Group (AMG) will assure that CM2 is properly aligned on its stand in the NML enclosure. FNAL AMG will assure that CM2 is aligned by using the fiducials on the vacuum vessels of CM2 and the NML enclosure. FNAL AMG shall not adjust the alignment screws of the CM2 cold mass on the vacuum vessel without the involvement of the TD responsible engineer Tug Arkan.

9. Cavity string beam line vacuum will not be leak checked until the power coupler tuner motors are installed. The beamline vacuum leak check shall be conducted by CAF-MP9 clean room group with the assistance of the NML clean vacuum group. Clean room working protocols shall be strictly applied during leak check and backfilling of the beam line valves. It is recommended that the cavity string be left under vacuum after the leak check.
10. AD NML group will install the beam line extension spool pieces in order to assemble the feed can and end can to CM2. The assembly of the beam line extension spool pieces to the cavity string will require clean room assembly working protocols. Therefore CAF-MP9 clean room group shall work together with the AD NML clean vacuum group to perform these tasks. *Caution: The two gate valves assembled to the upstream and downstream end of the cavity string are open. The right angle valves assembled to the gate valves are closed and mechanically locked. The keys of these locks are secured with the TD responsible engineer Tug Arkan.*
11. Pressure test of the 2-phase helium lines of the module were done during the assembly at CAF. At NML, after the assembly of the 2-phase pipe of the cavities to the 300 mm GRHP and assembly to the feed and end cans, pressure test shall be done with the detailed procedure document which is at the mentioned CM2 documentation url. TD Responsible engineer Tug Arkan and Timergali Khabiboulline need to be present during the pressure test. *It is imperative that the insulating vacuum is not pumped down until the pressure test initial setup is completed.*

Phase-II Sign-offs:

Prepared by: <u></u> (Tug Arkan, Cryomodule Production Engineer)	Date: <u>5/1/2012</u>
Approved by: <u>Tom Peterson</u> (Tom Peterson, TD Engineering)	Date: <u>5/1/2012</u>
Approved by: <u></u> (Jerry Leibfritz, AD Engineering)	Date: <u>5/4/12</u>
Approved by: <u>Ken Premo</u> (Ken Premo, TD Engineering)	Date: <u>5/1/2012</u>
Approved by: <u></u> (Vyacheslav Yakovlev, TD SRF Dept. Head)	Date: <u>5.01.2012</u>
Approved by: <u>S Nagaitsev</u> (Sergei Nagaitsev, AD NML Head)	Date: <u>5/8/12</u>
Approved by: <u>Apollinari</u> (Giorgio Apollinari, TD Division Head)	Date: <u>5/1/12</u>

Approved by: Roger L. Dixon
(Roger Dixon, AD Division Head)

Date: 5-8-12

Phase – III: CM2 at NML after ORC is approved:

ORC documentation was prepared by TD engineers. ORC shall be approved by the TD and AD division heads before CM2 responsibility can be transferred to AD NML group for operation.

Responsibility of operation of CM2 at NML rests with AD staff led by Elvin Harms. Andy Hocker will be the lead person from TD.

It is highly recommended that for any planned repair or modification for CM2, the NML group shall contact the TD responsible engineer, Tug Arkan, or his designee Ken Premo. Especially beam line vacuum and backfilling operations are the most critical in order to preserve the gradient of the module, therefore CAF clean room group shall be consulted and involved for any planned tasks concerning the cavity string of CM2.

The Phase-III section will need to be worked on in detail before sign off signatures are needed.